THIRTIETH STREET STATION, LOAD DISPATCH CENTER HAER No. PA-404-B
30th and Market Street in the AMTRAK (formerly Pennsylvania)
Railroad Station
Philadelphia
Philadelphia County
Pennsylvania

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Philadelphia Support Office
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

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Location: 30th and Market Street in the Amtrak (formerly Pennsylvania) Railroad Station
Philadelphia
Philadelphia County
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UTM: 18.484480.4422700
Quad: Philadelphia, PA. - N.J., 1:24000

Date of Activation: March 3, 1935

Engineers/Designers: Gibbs & Hill, New York, NY

Manufacturer: Kellogg Switchboard & Supply Company, Chicago, Illinois.

Present Owner: National Railroad Passenger Corporation (Amtrak); Washington Union Station, 60 Massachusetts Ave. N.E. Washington, DC 20002

Present Use: Intact and in current use. The Load Dispatch Center model board will be replaced in the near future by a computerized load dispatch center.

Significance: The Load Dispatch Circuit and Switch Indicating Board was designed to visually and aurally indicate the operating status of the railroad's power system. This particular load dispatch center monitors and supervises electrical loads and power supply in the railroad's power distribution system from New York to Washington, D.C. The load dispatchers who work at this site oversee the electrical load on sections of the system. They are responsible for maintaining continuity and availability of power for operation of trains on the system. This is done on an interactive basis with personnel at utility generating stations to monitor and control voltage and power levels. The load dispatchers also issue work permits and switching orders to field crews. They are responsible for forecasting demand and insuring that adequate generating capacity is brought on line in a timely manner. The status of the system is shown on system schematic model board with small pilot lights. The load dispatcher records changes in system status by manually actuating indicating lights on the model board. The model board and operational system that evolved represents a pre-computer technology for centralized control of a electrified railroad power network.

Project Information: This documentation began on December 1, 1996 under a memorandum of agreement between the National Railroad Passenger Corporation and the Pennsylvania Historic and Museum Commission and the State Historic Preservation Officer as a mitigating measure prior to removal of the equipment. The Load Dispatch Center was documented to the professional standards of the National Park Service's Historic American Engineering Record. Additional mitigation includes donation of the equipment to a railroad or technology museum for installation as a permanent exhibit.

Robert C. Stewart - Historical Technologies
1230 Copper Hill Road, West Suffield, CT 06093

Introduction

This report continues documentation of historic railroad electrical control centers now and formerly located in Amtrak's Thirtieth Street Station, Philadelphia. HAER report No. PA-404A discusses the Power Director Center and should be referred to for additional information and to obtain a more complete depiction of the control facility.

The development of electrical generating and distribution systems in the waning years of the 19th century established a new power source for the country's growing railroads. Electrical energy was, and continues to be, an effective, economical, clean and practical source of railroad traction power. In general, it is the most cost-effective energy source in highly traveled, populated regions.

Concurrent with the employment of electric power, railroad engineers developed methods of controlling and monitoring its distribution and use. For an electric railroad to function, controlled power must be delivered trackside in sufficient quantity to allow multiple trains to run at scheduled operating speeds. Power also must be available to provide heat or air conditioning and run ancillary equipment. Supervision of power distribution and its regulation is the responsibility of workers designated as load dispatchers and power directors. Operating procedures charge these individuals with the responsibility of overseeing the electrical equipment in the system under their control. A load dispatcher is equivalent to a system operator in a power utility company while a power director is counterpart to a utility's distribution operator. The whole railroad is a comparable to a load center.

Power directors are responsible for coordinating power handling with train dispatchers and maintenance crews to insure safe work conditions on the catenary and transmission system. Load dispatchers maintain continuity and availability of power for operation of trains. They communicate with technicians and engineers at utility generating stations to maintain system integrity. Load dispatchers monitor, oversee control and maintain voltage and power levels on the railroad's electrical supply system.

In recent years the development of computer-based monitoring and control systems has made earlier electrical control schemes obsolete. In 1976, the Federal Railroad Administration, Amtrak and its engineering consultants prepared a specification that defined the elements for a computer-based control system for the Northeast Corridor. This system centralized train and electrification controls in one location. Amtrak designates the new system as the Centralized Electrification and Traffic Control System (CETC). The existing load monitoring and control equipment will be replaced by a new electronic monitoring system (EMS) that will be linked to other Amtrak control systems.

The Load Dispatch Center

Electrical energy for the Amtrak trunk lines from New York City to Washington, D.C. and Harrisburg, Pennsylvania is controlled and monitored from Philadelphia's Thirtieth Street Station (see location map and partial building plan). The model board located in the Load Dispatcher's Office, room No. 495, on the fourth floor of Amtrak's Philadelphia 30th Street Station depicts a schematic diagram of the power system operating circuits. This equipment formerly shared room No. 495 with the Power Directors Office and Circuit and Switch Indicating Board that was located immediately to its north.

The section of the room devoted to Load Dispatcher's equipment is 35'- 8" long by 33' - 9" wide and contains approximately 1203.5 square feet. The manufacturer designed a five-sided board open on the southeast side. The board would be about fifty-four and one-half feet long had it been designed as a linear facility. It partially encloses an area of about 695 square feet (see plan of general arrangement and axonometric drawing, room No. 495).

Operations

The main function of the load dispatcher is to maintain continuity and availability of power for operation of trains. To do this the dispatcher must communicate with utility personnel who directly control voltage and power levels. The system illustrates the precomputer technology used to oversee electric power distribution.

Electrical power in the transmission lines, substations and other components of Amtrak's electrified lines from New York to Washington, D.C. and Harrisburg, Pennsylvania is managed with support from the model board and its supervisory consoles (see delineation of Electrified Territory Location Map). The load dispatcher manually operates button switches on the console that activate pilot lights on the model board. These pilot lights show the relative location and operational position of normally open, normally closed, hand operated, line and ground switches located throughout the system. They also indicate the operating status of oil circuit breakers, disconnect switches and transformers (see delineation of a typical section of the load dispatch model board). The five-sided periphery of the model board encloses two operating button switch consoles, and an energy monitoring computer system (see photographs of the model board, consoles and associated equipment and axonometric view of the load dispatch center).

Steel panels coated with low-reflection satin black paint form the board. These measure twenty inches high, twenty-four inches wide and 1/8" thick. A 10 foot high, steel angle iron framework extending to the ceiling, supports the panels. The panels display a schematic

representation of the railroad's high voltage electrical transmission system delineated in white paint. The schematic shows power transmission lines, substations, hand operated and remotely controlled switches, circuit breakers, transformers and the relationship of these components to each other and the system. The back sides of the panels form a chassis for the indicating lights, cabling, relays, alarms and other operating components. Indicating lights are placed at locations approximately corresponding to the actual site positions of the breakers and switches they symbolize. The model board indicating lights operate on 24 volts. Most wiring is typical of the 1930s, that is, stranded copper with varnished cambric insulation.

The Kellogg Switch Board Company of Chicago built the display board and switch consoles. Kellogg, no longer in operation, was a highly reputable firm and had supplied similar model boards to other railroads. Typically, Kellogg used standard telephone relays, indicating pilot light bulbs and conventional, readily available components in its custom-designed boards and consoles. Mass produced to high quality standards by the Western Electric Company, telephone parts had a proven record of reliability. The designers expected that they would be available as repair parts for the foreseeable future.

Origins and Changes

The Engineering firm of Gibbs and Hill, which was prominent in several major railroad electrification projects during the early years of the 20th century, was responsible for the concept and engineering design of the load dispatch center and model board. Electric passenger service inaugurated on January 16, 1933. A power director found a hand written "installer's mark" on a column in the power directors office that gives evidence that the railroad started up the load dispatch center and power directors office on March 3, 1935 at 6:00 P.M. This was about the time that the Pennsylvania Railroad extended electric railroad service to Washington, D.C.

Control engineers modified the board over the years to reflect changes in the system. The railroad added and removed substations to balance power requirements. Additional generating stations and utility companies provided more power. Engineers modified the board to reflect these changes.

Form and Function

Modern model boards usually feature a linear layout. Contemporary facilities generally extend along one wall of a room. The original Philadelphia load dispatch model board may have been designed to fit available space. However, by wrapping the board around an axis, one

or two power directors could easily scan their respective zones from a central point. The original intent was to extend electrification to other adjoining areas served by the Pennsylvania Railroad. Additional space on the southeast side of the room was to have provided space for model board expansion.

Technology

The load dispatch model board schematic shows the 138 KV transmission schematic and ancillary switching equipment. The Load Dispatch center has a passive board, that is, changes in field equipment status do not automatically change indicating lights on the board. The load dispatcher turns indicating lights on or off by manually actuating button switches located on the console next to the operator's desk (see photograph of the button board).

In general, each symbol for a switch or breaker has a red pilot light on its left or top side and a green pilot light at its bottom or right side. The switches are single pole double throw types. In one position the switch lights the red pilot, in the other position the green pilot lights up. When a circuit breaker or switch feeding power to a section of the railroad system is opened or closed, the load dispatcher records its position by raising or lowering the appropriate button (see Schematic delineation - Electrified Territory - Amtrak - Northeast Corridor Operations).

Sketch of typical normally closed and normally open switch symbols on the model board. Red and green pilot lights are located as shown within the switch symbol.

This action energizes pilot lights that show the extent of activation or de-energization of the transmission circuits. Green lights denote switches or breakers that are open. Red lights show closed switches or breakers. The position of a line between the pilot lights shows the normal condition of a switch or breaker. White lights show that circuit protection is "off." Telephone is the primary means of communication between utility personnel, power directors, tower operators, dispatchers, supervisors and the load dispatcher.

Labor Force

The load dispatcher is a highly respected occupation in railroad labor hierarchy. The movement of trains depends on load dispatchers maintaining power on the system. Load dispatchers qualify for the job through an apprenticeship. Most load dispatchers started as electrician's helpers or linemen and worked on an "electric traction gang." After becoming thoroughly familiar with the types and locations of electrical equipment along the right-of-way, an electric traction employee might move on to a job as a gang foreman, foremen or assistant power director and remain in that job for twelve to eighteen months, working in the power director's office. After several years experience as a power director, the individual would spend four to six months as a load dispatcher trainee before moving out of trainee status and on to the regular roster.

The load dispatcher must be thoroughly familiar with the area served by the railroad and the personnel responsible for each phase of its operation. Communication skills are vital to the position; the load dispatcher must know where to get critical information when emergencies arise. Appendix A documents the load dispatcher's work day tasks.

The load dispatchers and power directors belong to the American Train Dispatchers Association (ATDA). Electricians and linemen are members of the Brotherhood of Maintenance of Way Employees (BMWE). One can go from the BMWE to the ATDA without losing seniority via a tri-party agreement with the carrier and the two unions.

While monitoring the system, load dispatchers are in contact with Amtrak's power directors, substation electricians, train dispatchers, tower personnel and utility personnel. The Load Dispatch Center is directly under the supervision of the Assistant Chief Engineer for Electric Traction of Amtrak, America's passenger railroad[a].

INDIVIDUALS ASSOCIATED WITH THE SITE

The Pennsylvania Railroad's electrification project in the 1930s employed several major engineering firms and contractors.
The Vare Construction Company of Philadelphia was responsible for installation of major

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[a] Amtrak was created by the Rail Passenger Service Act of 1970. Its genesis was a consortium of railroad companies preceded by the Pennsylvania Railroad. It is a semi-public organization financed by participating railroads, federal grants and government guaranteed loans. With the exception of commuter lines, all intercity passenger rail service is supplied by Amtrak which serves almost 500 stations.

sections of the line in the Philadelphia area. United Engineers & Constructors, Inc. constructed Pennsylvania (30th Street) Station, a central steam plant and distribution system, a freight station, the coach yards and the catenaries in the terminal zone. The Westinghouse Electric Company managed planning and execution of the electrification program. Westinghouse also designed, built and supplied electric terminal and switching locomotives, freight and passenger locomotives. Other prominent material suppliers were the Bridgeport Brass Company, General Electric, Allis-Chalmers, Union Signal, Baldwin Locomotive and the Lima Locomotive Works.

The Power Director's Office in Context

Frank J. Sprague, a prominent engineer associated with the electrification of the New York Central, researched the origins of the electric railroad. Sprague claimed that a blacksmith in Brandon, Vermont, by the name of Thomas Davenport, built the first model electric railroad in 1834. Sprague also documented that an electric locomotive ran on the Edinburgh-Glasgow railway in 1838 at a speed of four miles per hour. Other experiments followed during the mid-nineteenth century. In 1840 Henry Pinkus patented the use of rails for conducting current to an electric locomotive-Moses Farmer of Dover, New Hampshire operated an experimental electric railroad car in 1847. In 1850 Thomas Hall had an automatically-reversing car operating on battery power.

Around 1850 Professor Page of the Smithsonian obtained a grant from Congress and built a car with a double solenoid motor. It had a reciprocating plunger and fly wheel that gave its running gear a motion similar to a steam engine. It received power from one hundred "Grove elements" and had its first run on April 29, 1851 on a railroad running from Washington to Bladensburg, Maryland. Reportedly it attained "a fair rate of speed."

Frank Julian Sprague was an electrical engineer who worked with Edison developing equipment for an experimental electric locomotive in 1885. He built the first large scale trolley system in the United States at Richmond, Virginia in 1888. Once it was available, the public demanded a transportation system that didn't rely on animal power with its need to care for thousands of horses and clean up tons of manure. Consumer demand fueled development of electrically propelled vehicles that evolved rapidly during the 1880s and 1890s. Investors financed construction of electrified city transit lines and interurban routes, yet common carrier/mainline railroads continued running on steam power.

Sprague also developed a multiple unit (MU) control system that enabled individual electric cars to be combined into trains of any length and yet be controlled from a single master unit. Known as "the Father of Electric Transportation," Sprague had a long and distinguished career in the electric industry. He strongly influenced the electrification of the Long Island Railroad.

The Baltimore & Ohio Railroad reached the vicinity of New York City in 1889. Traffic through its eastern Maryland facilities expanded and created a serious operational bottleneck in Baltimore. At the time the railroad used car floats to ferry trains across the Patapsco River, a system that created additional expense and delays. To bypass the float operation, they built a new line, tunneling under central Baltimore. A shallow tunnel would have solved the railroad's problem but venting it would have caused distress to abutting property owners. Electrification, using a 600 volt direct current system was the preferred solution.

In 1895 the Baltimore and Ohio Railroad was close to achieving electric operation through the tunnel under Howard Street in central Baltimore. However, the New York New Haven & Hartford opened an electrified short branch line between Nantasket Beach and Pemberton, Massachusetts on June 3, 1895. This antedates the first experimental operation of the Baltimore & Ohio that occurred on June 27, 1895. The Baltimore & Ohio's first train ran on July 1, 1895.

The Pennsylvania railroad experimented with electricity; it had a prototype 600 volt DC system using an overhead trolley operating on the Burlington and Mount Holly branch in NJ in 1895. The Pennsylvania electrification was purely a local light rail transit system and did not use detachable electric locomotives for propulsion. Service was provided by multiple-unit cars similar to those used on interurban transit systems.

Although the railroads serving metropolitan New York had been experimenting with electric traction for several years, a tragedy in 1902 compelled prompt construction of an electrified system. A wreck on January 8th killed seventeen people in a smoke-filled tunnel leading into the original Grand Central Station. The disaster resulted in legislation banning steam engines from New York City.

In 1904 The New York, New Haven & Hartford Railroad decided to electrify its line from Stamford, Connecticut, to Woodlawn, New York. At Woodlawn, New Haven trains would continue to New York City over the electrified lines of the New York Central, a combined total of 33 miles. Powered up in June of 1907, this was the first trunk-line electrification in the United States.

The Pennsylvania Railroad appreciated the possibilities of the single-phase, high voltage, alternating-current system adopted by the New Haven. Employing a common system would allow maximum interchangeability of equipment and a more dependable power supply. It adapted the pioneering techniques of the Westinghouse Electric and Manufacturing Company and New Haven engineers Calvert Townley and William S. Murray to design an advanced railroad electric traction system.

The alternating-current system would power high-speed motive power units, have a dependable power supply from railroad and utility sources, be resistant to failure and have equipment interchangeable with other railroads. The new electric system also would require less maintenance.

The first section of the Pennsylvania line to be electrified was from Manhattan Transfer, near Newark, New Jersey, through the two single track tunnels under the Hudson River to the Pennsylvania station in New York City. Completed in 1910, the electrified section continued through four single track tunnels under the East River to the Sunnyside yard in Queens on Long Island.

The Manhattan-Sunnyside segment had been electrified earlier by Frank Sprague in 1905 as a 675 volt direct current third-rail system for the Long Island Railroad. The railroad considered eventual change over to an alternating-current system from the start and tunnels and clearances provided for an overhead catenary power supply. They switched over the whole section to alternating current when they built the Manhattan Transfer segment.

Electrification of suburban service in the Philadelphia area
started in 1915 and proceeded gradually until 1932 when it included all suburban service in metropolitan Philadelphia.

The railroad announced plans to electrify the line between Manhattan Transfer and Washington, D.C. in 1928. The Pennsylvania Railroad inaugurated electric passenger service between New York and Philadelphia on January 16, 1933. The project cost 100 million dollars. Electric locomotives moved trains only as far south as Wilmington, Delaware at this time. By 1935 the railroad completed electrification of the line as far as Washington.

Sources of Information/Bibliography

Engineering Drawings:

Drawing No. 387D40; Office of Electrical Engineer. The Pennsylvania Railroad - Electrified Railroad Location Map; Originally dated June 15, 1936. Revised December 23, 1955; December 18, 1959; February 1, 1960 and November 28, 1962. Located at Amtrak - Electric Traction Department - 30th Street Station, 30th and Market Street, Philadelphia, PA 19104.

Drawing No. 390-EE-96; Electrified Territory - Power System Operating Diagram; Electrical schematic from the Office of the Chief Engineer, Northeast Corridor Operations. Originally dated May 31, 1996 with several revisions through June 31, 1996. Located at Amtrak - Electric Traction Department - 30th Street Station, 30th and Market Street, Philadelphia, PA 19104.

Documents:

Load Dispatcher - Representative Work Day Tasks - Document located in Load Dispatchers Office, 30th Street Station, 30th and Market Street, Philadelphia, PA 19104.

Interviews:

Eloise Amentt - Senior Load Dispatcher
Date: January 9, 1997; 11:00 A.M.
Location: Load Dispatcher Office, 30th Street Station, Philadelphia, PA

Bob Megowen - Load Dispatcher
Date: January 8, 1997
Location: Load Dispatcher Office, 30th Street Station, Philadelphia, PA

Austin Nagle - Load Dispatcher
Date: January 8, 1997
Location: Load Dispatcher Office, 30th Street Station, Philadelphia, PA

J. Steven Roberts - Load Dispatcher Special Duty-EMS
Date: March 7, 1995; 11:00 A.M.
Location: Power Director Center, 30th Street Station, Philadelphia, PA

Kenneth Yeager - Load Dispatcher
Date: March 8, 1995; 4:00 P.M.
Location: Load Dispatcher Office, 30th Street Station, Philadelphia, PA

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Supplemental material:

APPENDIX A
LOAD DISPATCHER - REPRESENTATIVE WORK DAY TASKS

1. Check with all generating stations by telephone or computer to determine their operating status.

2. Determine which facilities are running in "condenser" mode (running reserve power) and can supply voltage support. Pinpoint alternative supplies of power to mitigate any conceivable power problems.

3. Review the Load Dispatcher's request calendar. Contact all seven power directors and confirm any permits to remove power for maintenance and bridge construction projects.

4. Prioritize permit requests as follows:
   a. Maintain system integrity
   b. Requests affecting revenue
   c. Contractor management

5. Determine order (time) of cuts and outages on the system. Normally this order is set up the day before - weather conditions may dictate changes.

6. Activate plan - issue permits so that the power directors can issue clearances to field personnel.

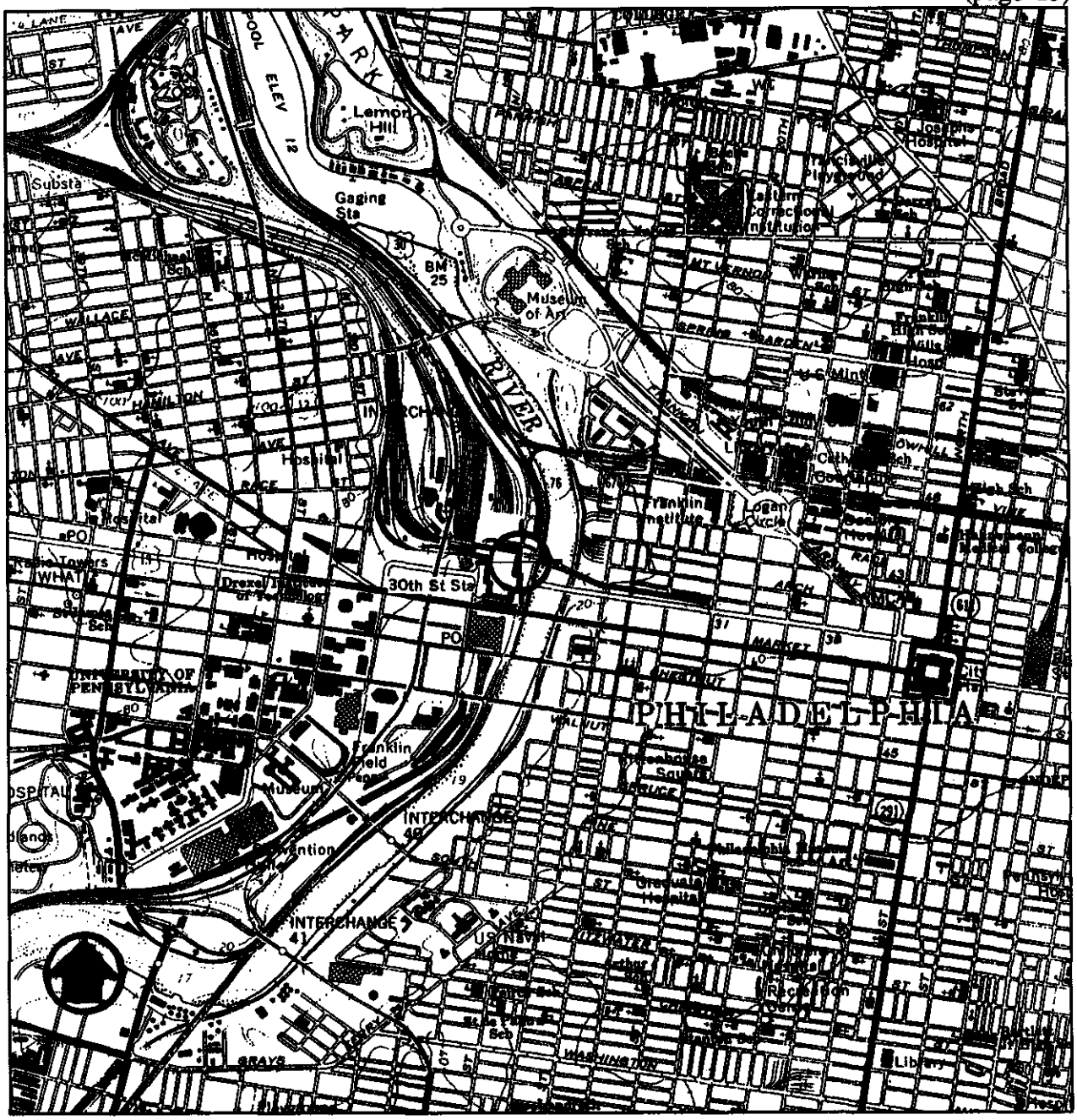
7. Prepare load dispatchers requests for the next day's operations.

8. Check with New Jersey Transit, Southeast Pennsylvania Transit Authority and all generating stations is switching operations are involved with these organizations.

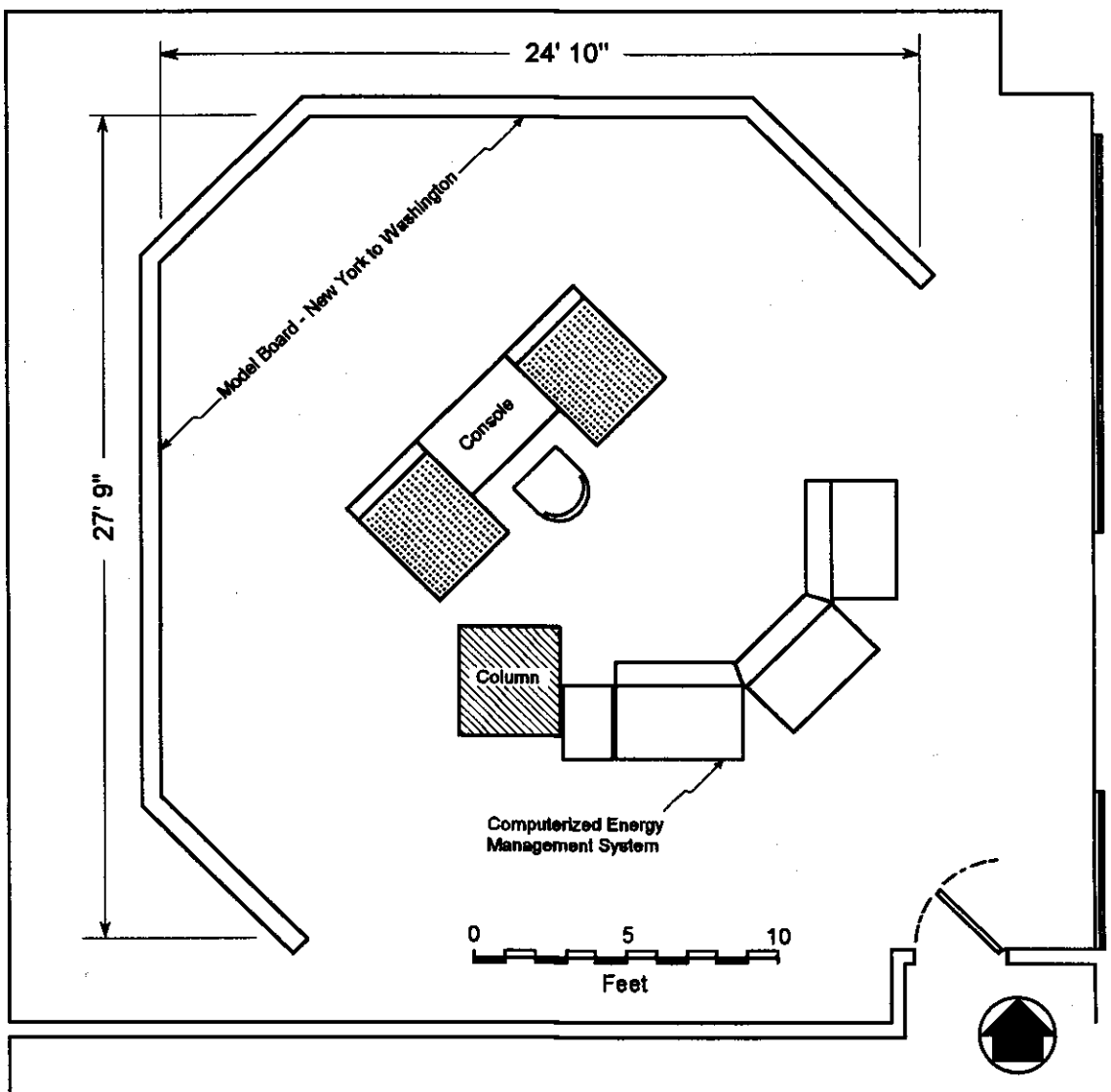
9. Obtain the power director's report on clearances - issue instructions to restore power to off-line sections of the system.

10. Record work done by field crews, incidents of power loss, equipment failure in substations, transmission lines, signals or other facilities which could delay trains and deliver this information to management.

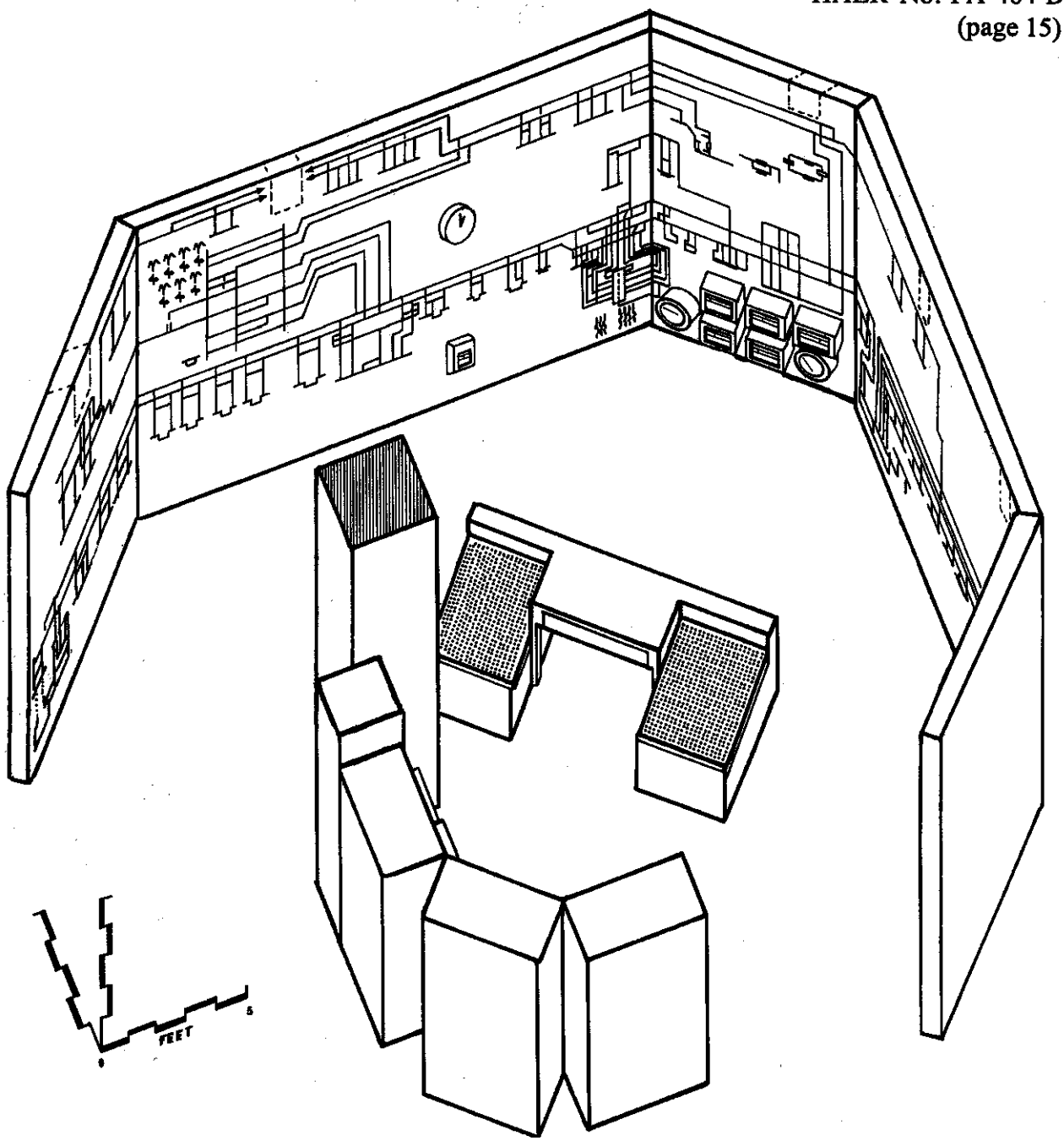
Note: This is a copy of a document posted in the Load Dispatchers Office, 30th Street Station, Philadelphia, PA.



Location Map-Thirtieth Street Station, Power Director Center
Quadrangle; Philadelphia, Pennsylvania 1:24000



Thirtieth Street Station, Load Dispatch Center
Plan of general arrangement, Room No. 495



Thirtieth Street Station, Load Dispatch Center
Switch Consoles and Model Board - Axonometric View